

March 1, 1888.

Professor G. G. STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

In pursuance of the Statutes, the names of the Candidates for election into the Society were read from the Chair, as follows:—

Andrews, Thomas, F.R.S.E.	Halliburton, William Dobinson, M.D.
Bosanquet, Robert Holford Macdowall, M.A.	Henslow, Rev. George, M.A.
Bottomley, James Thomson, M.A.	Howorth, Henry Hoyle.
Boys, Charles Vernon.	Hughes, Professor Thomas McKenny, M.A.
Burbury, Samuel Hawkesley, M.A.	Jervois, Sir William Francis Drummond, Lieut.-Gen. R.E.
Buzzard, Thomas, M.D.	King, George.
Cameron, Sir Charles Alexander, M.D.	Lapworth, Professor Charles, LL.D.
Carnelley, Professor Thomas, D.Sc.	MacMunn, Charles, M.D.
Church, Arthur Herbert, M.A.	Martin, John Biddulph, M.A.
Clark, John Willis, M.A.	Matthey, Edward, F.C.S.
Clarke, Alexander Ross, Colonel R.E.	Ord, William Miller, M.D.
Corfield, William Henry, M.D.	Palmer, Henry Spencer, Colonel R.E.
Cunningham, Professor Daniel John, M.D.	Parker, Professor T. Jeffery.
Cunningham, Professor David Douglas, M.B.	Pedler, Professor Alexander, F.C.S.
Dickinson, William Howship, M.D.	Pickering, Professor Spencer Umfreville, M.A.
Elgar, Professor Francis, LL.D.	Poulton, Edward B., M.A.
Fletcher, Lazarus, M.A.	Poynting, Professor John Henry, M.A.
Galloway, William.	Priestley, William Overend, M.D.
Gordon, James Edward Henry, B.A.	Ramsay, Professor William, Ph.D.
Greenhill, Professor Alfred George, M.A.	Sanders, Alfred, M.R.C.S.
	Sankey, Matthew Henry P. R., Capt. R.E.

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Seebohm, Henry, F.L.S.	Thorne, Richard Thorne, M.B.
Sharp, David, M.B.	Tidy, Professor Charles Meymott, M.B.
Shaw, Professor Henry Selby Hele, M.I.C.E.	Tizard, Thomas Henry, Staff-Commander.
Sollas, Professor William John-son, D.Sc.	Todd, Charles, M.A.
Stevenson, Thomas, M.D.	Tomlinson, Herbert, B.A.
Stewart, Major-Gen. J. H. M. Shaw, R.E.	Topley, William, F.G.S.
Stokes, Sir William, M.D.	Trimen, Henry, M.B.
Teale, Thomas Pridgin, F.R.C.S.	Ulrich, Professor George Henry Frederic, F.G.S.
Tenison-Woods, Rev. Julian E., M.A.	Ward, Professor Henry Marshall, M.A.
Thomson, Professor John Millar, F.R.S.E.	White, William Henry, M.I.C.E.

The following Papers were read:—

- I. "On the Changes produced by Magnetisation in the Dimensions of Rings and Rods of Iron and of some other Metals."
By SHELFORD BIDWELL, M.A., F.R.S. Received February 9, 1888.

(Abstract.)

In a paper communicated to the Royal Society in 1885,* the author has shown that the elongation which an iron rod undergoes when magnetised does not, as had been generally believed, remain unchanged at a maximum when the magnetising force exceeds that which is sufficient to produce so-called saturation. On the contrary, he finds that when the magnetising force is continually increased beyond this limit, the elongation becomes gradually less and less, until the rod, after first returning to its original length, ultimately becomes actually *shorter* than when in the unmagnetised condition.

The experiments described in that paper are, however, open to objection, on the following grounds:—(1) The field due to the magnetising solenoid was not quite uniform; (2) the effect of the ends of the rods was uncertain, and might have played some material part in the production of the phenomena in question; (3) all the rods used in the experiments retained a certain amount of permanent magnetism; (4) the experiments might with advantage have been carried further. The paper now offered to the Society contains an account of some new experiments which were designed to meet the above objections.

Objections (1) and (2) were met by using rings instead of rods of

* 'Roy. Soc. Proc.,' vol. 40, 1886 (No. 242, p. 109).

iron, observations being made of the changes which occurred in their diameters under the influence of various magnetising forces obtained by passing currents of electricity through coils of wire encircling the rings. To remove the third objection the rings were demagnetised before every observation, by a modification of the method described by Professor Ewing in the 'Phil. Trans,' vol. 176, p. 537. And lastly, the battery employed was increased from seven Grove's cells to thirty.

After an explanation of the precautions taken to guard against the effects of current heating, an account is given of some experiments with three rings arranged in slightly different ways, and the results are compared with those of an experiment made under similar conditions with a straight rod. It was found that in their general character the phenomena of elongation and retraction were just the same in both cases, and were in close agreement with those of the former paper. The differences in mere details were not greater than would probably be found to occur in different specimens of iron of the same form.

Being satisfied that these curious effects of magnetism were practically independent of the form of the iron, and having regard to the fact that it was much easier to obtain intense fields with straight than with circular solenoids, the author thought it worth while to make some further experiments with straight rods. The metals used in addition to iron were cobalt, nickel, manganese-steel, and bismuth; and the highest magnetising force reached about 840 C.G.S. units, the maximum in the old experiments having been 290.

It was found that the retraction of the iron continued to increase with higher forces until it was finally as much as 45 ten-millionths of the length of the rod, when there were indications that a limit was being approached. The retraction of the nickel reached 113 ten-millionths, when it also was evidently not far from its limit.*

The behaviour of the cobalt rod was exceedingly curious and interesting. No evidence of any change of length appeared until the magnetising force exceeded 30 or 40 units. Then the length of the rod began to diminish, and continued diminishing until the force was about 400, when the retraction amounted to 50 ten-millionths. But beyond this point the rod gradually became longer again, and the retraction with the highest force of 800 units was only three-fifths of its maximum amount. It was ascertained that the maximum retraction did not coincide with a maximum of magnetisation, as might have been suspected to be the case. It is suggested that iron and nickel might possibly behave in a similar manner under sufficiently high magnetising forces.*

* It is also suggested that some specimens of cobalt and nickel might, like iron, begin with a small preliminary elongation, thus accounting for Professor Barrett's observation that cobalt undergoes elongation when magnetised ('Nature,' vol. 26, p. 535).

Tables and curves are given showing the relation between magnetising force and changes of length in each metal.

Bismuth was found to be slightly elongated in strong fields, though no change could be detected with forces of less than about 500. The greatest elongation observed was about 1·5 ten-millionths of length.

Manganese-steel was almost unaffected. The elongation in a field of 850 was estimated to be about one fifty-millionth of the length.

Finally, it is shown that the mechanical stress produced in iron by magnetism does not account for more than one-fifth part of the observed magnetic retraction.

An Appendix to the paper contains evidence of the high degree of accuracy obtainable by the method of observation employed. In the very great majority of the measurements of elongation and retraction, the probable error was less than one two-and-a-half-millionth part of an inch, or one hundred-thousandth of a millimetre; and the results of experiments made upon different days (the apparatus having been in the meantime dismantled), or with currents of ascending and of descending strength, were strikingly concordant. This degree of precision is attributed to the perfection of the optical arrangements, which rendered it possible to project the image of a wire with such sharpness, that after reflection from a mirror its position upon a scale 24 feet (732 cm.) distant could be read to a quarter of a scale division, each whole division being equal to $\frac{1}{10}$ -inch (0·64 mm.). The magnifying power was such that a change of one two-and-a-half-millionth part of an inch (or one hundred-thousandth of a millimetre) in the length of the rod under examination caused the image of the wire to move through about three-quarters of a scale division. More accurately, a scale division corresponds to 0·000018 mm.

The currents used were measured by one of Ayrton and Perry's commutator ammeters, and the accuracy with which the magnetising forces were estimated, though quite sufficient for the purpose of the experiments, does not claim to be very high.

II. "On Electrical Excitation of the Occipital Lobe and adjacent Parts of the Monkey's Brain." By E. A. SCHÄFER, F.R.S., Jodrell Professor of Physiology in University College, London. Received February 13, 1888.

The cortex of the occipital lobe has been explored electrically by Ferrier and by Luciani and Tamburini. In ten experiments upon monkeys Ferrier was unable to obtain any movements on stimulation of this part. Excitation of the angular gyrus produced conjugate deviation of both eyes to the opposite side, with sometimes an up-